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May 23, 1996

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Specification

1. Title of the Invention

A disc substrate manufacturing device and a method for its manufacture.

2. Claims

(1) A disc substrate manufacturing device, characterized in that, in a device for injection molding or injection compression molding of a disc substrate, a stamper coated with a layer of synthetic resin is placed on the core molding surface of the metal mold.

(2) The disc substrate manufacturing device of Claim (1), characterized in that the synthetic resin is conductive.

(3) The disc substrate manufacturing device of Claim (1), characterized in that the synthetic resin has been subjected to electrostatic processing.

(4) A method for manufacturing a disc substrate manufacturing device, characterized in that, in a method for manufacturing a device for injection molding or injection compression molding of disc substrates, a synthetic resin layer is formed on the stamper, and the aforementioned stamper having a layer of synthetic resin formed on it is installed on the core molding surface of the metal mold.

(5) The method for manufacturing a disc substrate manufacturing device of Claim (4), characterized in that the method for forming a synthetic resin layer on the stamper is the coating method.

(6) The method for manufacturing a disc substrate manufacturing device of Claim (4), characterized in that the method for forming a synthetic resin coating on the stamper is the lamination method.

3. Detailed Description of the Invention

Fields of Industrial Use

The present invention relates to a device for manufacturing disc substrates for optical discs, optomagnetic discs, etc., and a method for its manufacture.

Prior Art

Manufacturing and development of substrates for video discs, compact discs, recordable and erasable optical discs, and optomagnetic discs is carried out by means of injection molding or injection compression molding. Molding of the disc substrate is carried out by thin-walled precision molding, with vital factors including increasing precision of metal molds, development of resin materials, and development of molding conditions such as metal mold temperature, cylinder temperature, injection pressure, and injection rate. Numerous factors are required in the case of substrates for optical-type discs, and among these, important considerations are that birefringence, caused by molecular chain orientation and residual distortion during molding of molded products, must be small, and that the transferability of guide channels for signal bits or tracking must be favorable. These factors can be

improved by means of developing resin materials (which must have a low photoelastic coefficient and favorable melt flow properties) and setting molding conditions, e.g.: (1) increasing the cylinder temperature to increase flow properties of the resin material; (2) increasing the metal mold temperature; (3) keeping injection pressure as low as possible; and (4) making the injection rate as fast as possible. However, there are limitations on the individual conditions mentioned under (1)-(4) above, e.g., in the case of (1), the problem of thermal deterioration of the resin material, and in the case of (2), the problem of prolongation of cooling time, preventing cycle shortening and causing warping of the disc substrate. In the case of (3), birefringence is improved, but the internal pressure of the resin drops, making transfer of the signal poor. In (4), there is a tendency toward excess filling, making control difficult, and it has been difficult to find a complete solution for these problems (Plastic Age, Mar. 1984. pp. 103-106).

On the other hand, concerning the structure of the metal mold, as is the case for ordinary molded products, attention has been focused only on speeding up the cooling and hardening rate of the molten resin as much as possible in order to improve productivity. Fig. 3 shows a schematic sectional diagram of a conventional metal mold for molding of disc substrates (Japanese Unexamined Patent Application No. 83-151223).

In Fig. 3, 1 is a fixed die plate, 2 is a mobile die plate, 3 is a fixed side core, 4 is a mobile side core, 5 is a stamper tightening component, 6 is a stamper pressing ring, 7 is a cavity, 8 is the stamper, 9 and 10 are grooves for cooling medium for cooling the molten resin, 11 is a spray component, and 12 is an injection cylinder.

Concerning the disc substrate, for example, in injection molding, in the case of the metal mold shown in Fig. 3, the molten resin injected from the injection cylinder 12 passes through the spray component 11 and fills the cavity. In the die plate on one side of this metal mold (mobile die plate 2 in Fig. 3), a stamper 8 which has guide channels for signal bit or tracking purposes is held in place using a stamper tightening component 5 on the inner periphery and a stamper holding ring 6 on the outer periphery. In this type of configuration, as the cavity fills with molten resin, the pressure inside the cavity increases and signal transfer is carried out, and at the same time, the stamper 8 is brought directly into contact with the mobile side core 4, and hardening of the molten resin takes place. This type of injection has the effect of eliminating anything between the stamper and the core so that direct contact can occur in order to remove heat from the resin material filling the metal mold as rapidly as possible, thus shortening the cooling period until mold opening occurs.

However, in molding the disc substrate, in order to improve the aforementioned birefringence, signal bits, and transferability of the guide channels, it is preferable to remove the heat from the molten resin until the internal cavity 7 pressure of the injected molten resin has been transferred to a sufficient degree. The reason is clearly that in ordinary molding, because the metal mold temperature is set at a level approximately 10-40°C lower than the thermal deformation temperature, injection causes the surface layer of the resin material, which is in contact with the cavity 7 surface of the metal mold, to immediately harden, decreasing transferability and causing force to be exerted during hardening, causing residual deformation and resulting in poor birefringence.

However, as a method for improving the decrease in birefringence caused by the above-mentioned factors, it is possible to insert a sheet between the stamper 8 and the metal mold mobile side core 4, but in this case, it is clear that it becomes very difficult to carry out installation, there is an increase in the surface to which dust can adhere, and there is a possibility of bump defects.

Problems to be Solved by the Invention

The present invention solves the above-mentioned problems of conventional technology occurring in cooling of the injected molten resin in the cavity by comprising a method for manufacturing disc substrates in which materials can be obtained with a favorable yield in which favorable birefringence and transferability, vital properties for disc substrates for optical discs, optomagnetic discs, etc., can be obtained.

Means for Solving Problems

As the method for manufacturing disc substrates of the present invention comprises a method in which, in injection molding or injection compression molding of disc substrates, a stamper having a synthetic resin layer applied as a laminated sheet is installed in a metal mold core, it thus solves the above-mentioned problems.

Action

In the method for manufacturing disc substrates of the present invention, when the injected molten resin flows into the cavity of the metal mold, thermal conduction from the molten resin to the cooling medium for cooling the molten resin placed in the metal mold is decreased, the rate of cooling of the molten resin is slowed, and apparently, the cylinder temperature increases and the fluidity of the molten resin is

improved, obtaining the same effect as if the metal mold temperature had been increased, and together with increasing transferability, a vital property for the disc substrate, the rate of hardening is slowed, and by applying power before hardening has proceeded, deformation is reduced, thus improving birefringence. By means of the stamper in which a synthetic resin layer is applied as a laminated sheet, one can easily carry out the operation of installing the stamper, and as the surface to which dust adheres also decreases by 2 [illegible] (one surface of the sheet, stamper [illegible]), one can greatly reduce the number of defects caused by dust adhesion, thus improving the manufacturing yield of disc substrates.

Practical Example

The following is an explanation of the present invention by means of a practical example, with reference to the figures. Fig. 1 shows a sectional diagram of a metal mold for manufacturing disc substrates according to the present invention. This corresponds to the conventional example shown in Fig. 3. In this practical example, a laminated body composed of the synthetic resin layer 13 applied to the surface of the stamper 8 is applied to the mirror surface of the mobile side core 4 using the stamper tightening component 5. Examples of synthetic resin coatings include substances having adiabatic properties and having conductivity at or above the level required to prevent static electricity, such as polyimide-class film and polyimide-class resin. Concerning the method for lamination of the stamper 8 and the synthetic resin film 1 [illegible], examples include the method of applying the synthetic resin to a nickel stamper surface using a spinner, etc., and the method of lamination of a substance composed of a thermosetting adhesive (epoxy class) applied to a synthetic resin film. Moreover, concerning adhesive force during lamination of the stamper and the synthetic resin, in order to make lamination of the stamper easier, temporary adhesive force may also be used.

Fig. 2 is a sectional expanded diagram of the component parts of Fig. 1, i.e., the stamper 8, the synthetic resin layer 13, the mobile side core 4, and the thermosetting adhesive 14. By means of this configuration of the invention, installation of the stamper becomes easy and the process of hardening of the molten resin is slowed, making it possible to manufacture a material having favorable birefringence and transferability in a good yield.

Effect of the Invention

As described above, in the method for manufacturing disc substrates of the present invention, as a stamper having a synthetic resin layer applied as a laminated sheet is installed on the core molding surface of the metal mold in injection molding or injection compression molding of disc substrates, one can obtain products having outstanding birefringence and transferability. In past technology, the stamper surface and the mirror surface of the core surface were directly in contact for each shot, but in the present invention, as a sheet is interposed, this has the secondary effect of extending the life of the stamper and the metal surface of the core of the metal mold. Moreover, as the synthetic resin and the stamper form a laminated sheet, this installation can be easily carried out, one can decrease bump defects due to dust, and this has the effect of allowing manufacturing of disc substrates with a good yield.

4. Simplified Explanation of the Figures

Fig. 1 shows a sectional diagram of a metal mold used for manufacturing of a disc substrate in the practical example of the present invention, Fig. 2 shows a partially expanded sectional view of Fig. 1, and Fig. 3 is a sectional diagram of a metal mold for manufacturing a disc substrate showing a conventional example.

1: Fixed die plate, 2: Mobile die plate, 3: Fixed side core, 4: Mobile side core, 5: Stamper tightening component, 6: Stamper pressing ring, 7: Cavity, 8: Stamper, 9, 10: Channel for cooling medium for cooling of molten resin, 11: Spray component, 12: Injection cylinder, 13: Synthetic resin layer.

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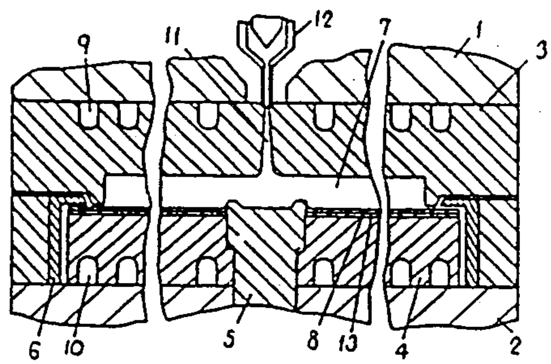
Fig. 1
1. Fixed die plate
2. Mobile die plate
3. Fixed side core
4. Mobile side core
5. Stamper tightening component
6. Stamper pressing ring
7. Cavity
8. Stamper
9, 10. Channel for cooling medium for cooling molten resin
11. Spray component
12. Injection cylinder
13. Synthetic resin layer



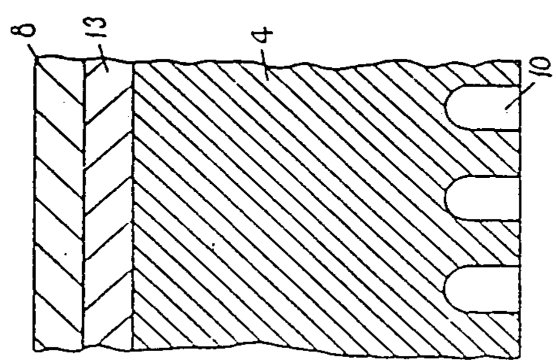


Fig. 2

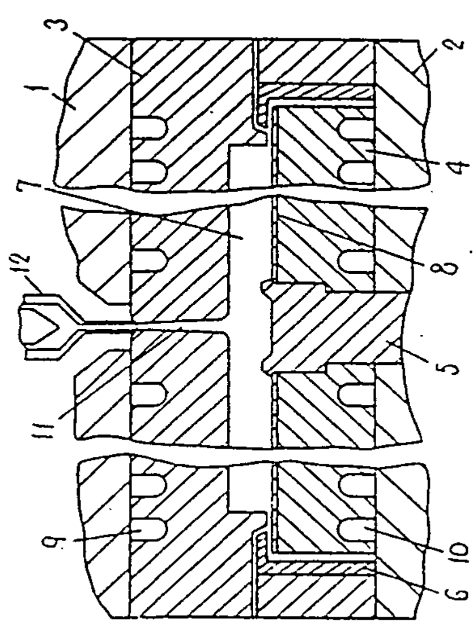


Fig. 3